



DEPARTMENT OF HEALTH AND HUMAN SERVICES

Food and Drug Administration

21 CFR Part 888

[Docket No. FDA-2014-N-1205]

Orthopedic Devices; Reclassification of Pedicle Screw Systems, Henceforth To Be Known as Thoracolumbosacral Pedicle Screw Systems, Including Semi-Rigid Systems

AGENCY: Food and Drug Administration, HHS.

ACTION: Final order.

SUMMARY: The Food and Drug Administration (FDA) is issuing a final order to reclassify pedicle screw systems, a preamendments class III device (regulated under product code NKB), into class II (special controls), renaming the device "thoracolumbosacral pedicle screw systems"; reclassify dynamic stabilization systems, a subtype of pedicle screw systems regulated under product code NQP when used as an adjunct to fusion, into class II (special controls), renaming this device subtype "semi-rigid systems"; and clarify the device identification of pedicle screw systems to more clearly delineate between rigid pedicle screw systems and semi-rigid systems. FDA is finalizing this action based on a reevaluation of information pertaining to the device type.

DATES: This order is effective on [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]. See further discussion in section V, "Implementation Strategy."

FOR FURTHER INFORMATION CONTACT: Constance P. Soves, Center for Devices and Radiological Health, Food and Drug Administration, 10903 New Hampshire Ave., Bldg. 66, rm. 1437, Silver Spring, MD 20993, 301-796-6951, [Constance.Soves@fda.hhs.gov](mailto:Constance.Soves@fda.hhs.gov).

**SUPPLEMENTARY INFORMATION:****I. Background--Regulatory Authorities**

The Federal Food, Drug, and Cosmetic Act (the FD&C Act), as amended by the Medical Device Amendments of 1976 (the 1976 amendments) (Pub. L. 94-295), the Safe Medical Devices Act of 1990 (Pub. L. 101-629), the Food and Drug Administration Modernization Act of 1997 (Pub. L. 105-115), the Medical Device User Fee and Modernization Act of 2002 (Pub. L. 107-250), the Medical Devices Technical Corrections Act (Pub. L. 108-214), the Food and Drug Administration Amendments Act of 2007 (Pub. L. 110-85), and the Food and Drug Administration Safety and Innovation Act (FDASIA) (Pub. L. 112-144), among other amendments, established a comprehensive system for the regulation of medical devices intended for human use. Section 513 of the FD&C Act (21 U.S.C. 360c) established three categories (classes) of devices, reflecting the regulatory controls needed to provide reasonable assurance of their safety and effectiveness. The three categories of devices are class I (general controls), class II (special controls), and class III (premarket approval).

Under section 513(d) of the FD&C Act, devices that were in commercial distribution before the enactment of the 1976 amendments, May 28, 1976 (generally referred to as preamendments devices), are classified after FDA has: (1) Received a recommendation from a device classification panel (an FDA advisory committee); (2) published the panel's recommendation for comment, along with a proposed regulation classifying the device; and (3) published a final regulation classifying the device. FDA has classified most preamendments devices under these procedures.

Devices that were not in commercial distribution prior to May 28, 1976 (generally referred to as "postamendments devices") are automatically classified by section 513(f) of the

FD&C Act into class III without any FDA rulemaking process. Those devices remain in class III and require premarket approval unless, and until, the device is reclassified into class I or II or FDA issues an order finding the device to be substantially equivalent, in accordance with section 513(i) of the FD&C Act, to a predicate device that does not require premarket approval. The Agency determines whether new devices are substantially equivalent to predicate devices by means of premarket notification procedures in section 510(k) of the FD&C Act (21 U.S.C. 360(k)) and part 807 (21 Code of Federal Regulations (CFR) part 807).

A preamendments device that has been classified into class III and devices found substantially equivalent by means of premarket notification (510(k)) procedures to such a preamendments device or to a device within that type (both the preamendments and substantially equivalent devices are referred to as preamendments class III devices) may be marketed without submission of a premarket approval application (PMA) until FDA issues a final order under section 515(b) of the FD&C Act (21 U.S.C. 360e(b)) requiring premarket approval.

Under section 515(i)(2) of the FD&C Act, FDA has the authority to issue an administrative order revising the proposed classification of a device for which FDA has classified as a class III device and for which no administrative order has been issued calling for PMAs under section 515(b) of the FD&C Act, so that the device is classified into class I or class II, after issuance of a proposed order, a meeting of a device classification panel, and consideration of the comments of a proposed order. In determining whether to revise the proposed classification of a device or to require a device to remain in class III, FDA applies the criteria set forth in section 513(a) of the FD&C Act. Section 513(a)(1)(B) of the FD&C Act defines class II devices as those devices for which the general controls in section 513(a)(1)(A) by themselves are insufficient to provide reasonable assurance of safety and effectiveness, but for

which there is sufficient information to establish special controls to provide a reasonable assurance of safety and effectiveness of a device.

On July 9, 2012, FDASIA was enacted. Section 608(a) of FDASIA amended section 513(e) of the FD&C Act, changing the mechanism for reclassifying a device from rulemaking to an administrative order.

Section 513(e) of the FD&C Act provides that FDA may, by administrative order, reclassify a device based upon "new information." FDA can initiate a reclassification under section 513(e) or an interested person may petition FDA to reclassify a preamendments device. The term "new information," as used in section 513(e), includes information developed as a result of a reevaluation of the data before the Agency when the device was originally classified, as well as information not presented, not available, or not developed at that time. (See, e.g., Holland-Rantos Co. v. United States Department of Health, Education, and Welfare, 587 F.2d 1173, 1174 n.1 (D.C. Cir. 1978); Upjohn v. Finch, 422 F.2d 944 (6th Cir. 1970); Bell v. Goddard, 366 F.2d 177 (7th Cir. 1966).)

Reevaluation of the data previously before the Agency is an appropriate basis for subsequent action where the reevaluation is made in light of newly available authority (see Bell, 366 F.2d at 181; Ethicon, Inc. v. FDA, 762 F.Supp. 382, 388-391 (D.D.C. 1991)), or in light of changes in "medical science" (Upjohn, 422 F.2d at 951). Whether data before the Agency are old or new data, the "new information" to support reclassification under section 513(e) must be "valid scientific evidence," as defined in section 513(a)(3) of the FD&C Act and 21 CFR 860.7(c)(2). (See, e.g., General Medical Co. v. FDA, 770 F.2d 214 (D.C. Cir. 1985); Contact Lens Mfrs. Ass'n v. FDA, 766 F.2d 592 (D.C. Cir. 1985), cert. denied, 474 U.S. 1062 (1986).)

FDA relies upon "valid scientific evidence" in the classification process to determine the level of regulation for devices. To be considered in the reclassification process, the "valid scientific evidence" upon which the Agency relies must be publicly available. Publicly available information excludes trade secret and/or confidential commercial information, e.g., the contents of a pending PMA. (See section 520(c) of the FD&C Act (21 U.S.C. 360j(c)).)

Section 513(e)(1) of the FD&C Act sets forth the process for issuing a final reclassification order. Specifically, prior to the issuance of a final order reclassifying a device, the following must occur: (1) Publication of a proposed order in the Federal Register; (2) a meeting of a device classification panel described in section 513(b) of the FD&C Act; and (3) consideration of comments to a public docket.

FDA published a proposed order to propose different classifications for rigid pedicle screw systems and semi-rigid systems (SRSs) in the Federal Register of November 12, 2014 (79 FR 67105) (2014 Proposed Order). Moreover, as explained in section II of the 2014 Proposed Order, on May 22, 2013, FDA held a classification meeting of the Orthopedic and Rehabilitation Devices Panel (the 2013 Panel) to discuss pedicle screw systems, which include rigid pedicle screw systems and SRSs. FDA received and has considered all the comments on the 2014 Proposed Order, as discussed in section III. Therefore, FDA has met the requirements under sections 513(e)(1) and 515(i)(2) of the FD&C Act.

## II. Device Description

Pedicle screw systems consist of multiple component devices made from a variety of materials that allow the surgeon to build an implant system to fit the patient's anatomical and physiological requirements. Such a spinal implant assembly may consist of a combination of hooks, screws, longitudinal members (e.g., plates, rods, plate/rod combinations), transverse or

cross connectors, and interconnection mechanisms (e.g., rod-to-rod connectors, offset connectors). Rigid pedicle screw systems provide immediate rigid fixation to the spinal column as an adjunct to spinal fusion procedures.

Since the 1998 classification (63 FR 40025, July 27, 1998), changes in technological characteristics have occurred, leading to the emergence of a new type of pedicle screw system, SRSs, previously referred to as dynamic stabilization systems (DSSs). SRSs are a subset of the pedicle screw systems regulated under § 888.3070 (21 CFR 888.3070). SRSs are defined as systems that contain one or more non-uniform and/or non-metallic longitudinal elements (e.g., polymer cords, moveable screw heads, springs) that allow more motion or flexibility (e.g., bending, rotation, translation) compared to rigid systems and do not provide immediate rigid fixation to the spinal column as an adjunct to spinal fusion procedures.

In the 2014 Proposed Order, FDA proposed to modify the identification language from the way it is presently written in § 888.3070(a) and sought comments on the means of providing distinction between rigid pedicle screw systems and pedicle screw systems that allow more motion or flexibility. As discussed in section III, FDA received several comments suggesting that § 888.3070 separate SRSs, which may allow for more flexibility than traditional rigid pedicle screw systems but still facilitate fusion, from truly "dynamic" systems that are intended for non-fusion use. Truly dynamic systems intended for non-fusion use are postamendments devices that are outside the scope of this regulatory action. FDA agrees with these comments and has modified the identification language from the way it is presently written in § 888.3070(a) to include SRSs.

FDA has also, on its own initiative, renamed "pedicle screw spinal system" as "thoracolumbosacral pedicle screw system" to clearly distinguish these devices from posterior cervical screw systems, which are not intended to be covered by § 888.3070.

### III. Public Comments in Response to the Proposed Order

In response to the 2014 Proposed Order, FDA received 15 comments from industry, trade organizations, professional societies, and individuals. Certain comments are grouped together under a single number because the subject matter of the comments is similar. The number assigned to each comment is purely for organizational purposes and does not signify the comment's value or importance or the order in which it was submitted. The comments that follow are grouped into those that pertain to rigid pedicle screw systems and those that pertain to SRSs.

#### A. Rigid Pedicle Screw Systems

Of the 15 comments received, several specifically referenced the proposal to reclassify rigid pedicle screw systems when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of degenerative disc disease (DDD) and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment). Some commenters agreed with the recommendation to reclassify these as class II devices (special controls), most of whom specifically stated that they agreed with the Agency that general and special controls can provide reasonable assurance of the safety and effectiveness of rigid pedicle screw systems.

(Comment 1) Some commenters did not agree with the proposal to reclassify rigid pedicle screw systems to class II (special controls). One comment stated that labeling special

controls are not appropriate risk mitigations and that clinical data should be required for these devices. Another comment noted that adverse events have been identified for rigid pedicle screw systems, and the final comment noted varied results in clinical literature, specifically citing a 1990 study by Matsuzaki et al. that found a 5.7 percent screw breakage rate (Ref. 1).

(Response 1) FDA disagrees that rigid pedicle screw systems for treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) should remain in class III. The Agency believes the labeling special controls proposed to inform users of the technological features of the device (including identification of device materials and the principles of device operation), intended use and indications for use (including levels of fixation), identification of magnetic resonance compatibility status, cleaning and sterilization instructions, and detailed instructions of each surgical step (including device removal) are appropriate to help mitigate the identified risks to health that may result from improper use of rigid pedicle screw systems. The Agency does not believe clinical data are necessary for rigid pedicle screw systems indicated for treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment). Clinical data from use of rigid pedicle screw systems for these indications were presented to the 2013 Panel to support reclassification to class II. Furthermore, non-clinical methods used to evaluate these devices have been demonstrated to adequately mitigate risks to health. FDA still retains the ability to request appropriate performance testing, including clinical data for individual devices with a different indication for use and/or different technological features that do not raise different questions of safety and effectiveness as compared to a predicate device, to demonstrate that the individual devices are as



safe and effective as the predicate device, if necessary. FDA acknowledges that rigid pedicle screw systems, like all medical devices, have risks to health, as evidenced by the adverse events noted by one commenter, and the breakage rate identified in the 1990 Matsuzaki et al. study cited by another commenter (Ref. 1). On May 22, 2013, FDA held the 2013 Panel meeting to discuss the current classification of rigid pedicle screw systems for treatment of degenerative disc disease and spondylolisthesis other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment, which are currently class III indications (Ref. 2). FDA is not aware of evidence that indicates there is a higher rate of screw fracture for the class III indications, which is the focus of this reclassification effort, compared to the class II indications. The 2013 Panel discussed the adverse events and clinical literature associated with rigid pedicle screw systems for all indications, and recommended that traditional, rigid pedicle screw systems as an adjunct to fusion for the treatment of DDD and spondylolisthesis other than severe grades 3 or 4, or degenerative spondylolisthesis with objective evidence of neurologic impairment be reclassified as class II (special controls).

FDA agrees with the 2013 Panel's recommendation for reclassification. The Agency believes, as stated in the 2014 Proposed Order, that the risks of rigid pedicle screw systems as an adjunct to fusion for the treatment of DDD and spondylolisthesis other than severe grades 3 or 4, or degenerative spondylolisthesis with objective evidence of neurologic impairment, are sufficiently understood based on valid scientific evidence, which enables FDA to establish special controls to provide reasonable assurance of safety and effectiveness of rigid pedicle screw systems.

(Comment 2) One commenter provided an additional recommendation for the identification language for rigid pedicle screw systems. Specifically, to more completely characterize components that may be used as a part of these systems, the commenter suggested adding sublaminar wires and cables to the list of components of these systems.

(Response 2) FDA disagrees with this proposed edit to the identification language. These additional components, while often used in conjunction with pedicle screw systems, are classified under a separate classification regulation and, therefore, are not appropriate to include under § 888.3070. However, in review of this information, FDA acknowledges that hooks (currently listed in the identification language for pedicle screw systems) are also classified under a separate classification regulation. Therefore, the Agency has also taken the opportunity to remove "hooks" from the revised identification language for rigid pedicle screw systems.

(Comment 3) One commenter recommended removing design characteristics as a special control because this should be a requirement of all premarket notifications. This commenter also recommended removing the word "rigid" from the identification.

(Response 3) FDA disagrees with the recommendation of this commenter to remove design characteristics as a special control. FDA considers this special control critical to help differentiate technological features for rigid pedicle screw systems from SRSs. Similarly, inclusion of the word "rigid" in the identification language is necessary to distinguish between these and SRSs.

(Comment 4) One commenter recommended revising the biocompatibility special control to state "compliance with biocompatibility standards."

(Response 4) FDA disagrees with this comment and has determined that it is most appropriate not to reference consensus standards within special controls because relevant

standards are subject to change over time. The special controls as worded allow for additional mechanisms by which manufacturers can meet the requirements to ensure conformity.

(Comment 5) One commenter recommended removing "wear" from the list of potential means by which a device could fail.

(Response 5) The risk of wear was raised at the 2013 Panel, specifically in the context of SRSs. FDA still considers there to be a potential for wear in traditional rigid systems as well and, therefore, has elected not to modify the definition of device failure accordingly.

(Comment 6) One commenter suggested editorial revisions to the risks and descriptive text associated with risks as outlined in the 2014 Proposed Order.

(Response 6) These edits were not considered to substantively change the intended meaning of the risks and associated mitigations and, therefore, FDA will not accept these suggested edits in this final order.

(Comment 7) One commenter provided several proposed edits that would impact § 888.3070(b)(1). Additionally, this commenter provided other editorial recommendations to the language from the 2014 Proposed Order.

(Response 7) While FDA agrees with the proposed modifications that would impact § 888.3070(b)(1), these will require a separate regulatory action because this section of the regulation is outside the scope of the call for information under section 515(i) of the FD&C Act. Edits that were proposed to the language from the 2014 Proposed Order did not materially impact the language within this final order.

In reviewing the 2014 Proposed Order, the comments received, and the 2013 Panel's recommendations, FDA is also making minor modifications to the identification for thoracolumbosacral pedicle screw systems. The identification for rigid pedicle screw systems

will be revised from "longitudinal members (e.g., plates, rods, plate/rod combinations)" to "longitudinal members (e.g., plates, rods including dual diameter rods, plate/rod combinations)" as the latter statement clarifies that dual diameter rods would be considered to be part of rigid systems rather than as "non-uniform longitudinal elements" specified under the definition of SRSs.

## B. SRSs

### 1. Identification

In the 2014 Proposed Order, FDA solicited comments to revise the identification language for pedicle screw spinal systems to distinguish between rigid pedicle screw systems and DSSs (now termed SRSs).

(Comment 8) While most commenters did not specifically comment on the proposed up-classification of SRSs to class III, approximately half of the comments suggested revisions to the definition of SRSs. These suggestions propose separating SRSs, which may allow for more flexibility than traditional rigid pedicle screw systems but still facilitate fusion, from truly "dynamic" systems that are intended for non-fusion use. Truly dynamic systems are postamendments devices that are outside the scope of this regulatory action.

(Response 8) FDA agrees with these comments and will henceforth refer to these systems as SRSs in this final order under § 880.3070(b)(3).

(Comment 9) Several commenters provided alternative identification language to FDA's initially proposed definition of DSSs, now termed SRSs, which was as follows: "Dynamic stabilization systems are defined as systems that contain one or more non-uniform and/or non-metallic longitudinal elements (e.g., polymer cords, moveable screw heads, springs) that allow more motion or flexibility (e.g., bending, rotation, translation) compared to rigid pedicle screw

systems and do not provide immediate rigid fixation to the spinal column as an adjunct [to] fusion." While most commenters agreed with the language that these systems "allow more motion or flexibility," there were several comments that disagreed with the technological features called out within this definition (i.e., non-uniform and/or non-metallic). For example, one commenter provided the case that an undersized metallic rod may allow for more flexibility than a larger non-metallic rod. Similar arguments were also made at the 2013 Panel, where the challenges of defining these systems based upon technological characteristics were also discussed. Accordingly, several commenters proposed modifications to the identification language of these systems based solely on intended use (i.e., not intended for immediate rigid fixation, or intended to allow more motion or flexibility compared to rigid systems). Two commenters did not specifically provide alternate language; however, these commenters provided data from clinical and non-clinical studies to support the argument that rods manufactured from polyetheretherketone (PEEK) perform similarly to traditional metallic rods (Refs. 3 to 5). Qi et al. demonstrated that subjects undergoing single posterolateral fusion with either titanium rods or PEEK rods showed no difference in adjacent segment disease, spinal alignment, or clinical outcomes (Ref. 3). A biomechanical study by Sengupta et al. shows similar restriction in range of motion for PEEK rods compared to both the traditional metallic rods and another SRS device (Ref. 4). Kurtz et al. collected and analyzed explanted PEEK and traditional metallic rods and concluded that the PEEK rod retrievals showed similar wear patterns compared to traditional rigid rods (Ref. 5). These commenters also used terminology to distinguish these types of systems (i.e., "semi-rigid systems"), which are used as an adjunct to fusion, from "non-rigid" or "flexible" systems, which are "intended for dynamic stabilization" of

the spine. An additional commenter also cited a cadaver study, which similarly showed that PEEK rods resulted in comparable stability to traditional metallic systems (Ref. 6).

(Response 9) In response to these comments, FDA has revised this identification to remove reference to "non-metallic" components and has also captured devices with less stiff materials (i.e., "features that allow more motion or flexibility compared to rigid systems"). FDA has also elected to alter the terminology used to identify these systems that "allow more motion or flexibility" when used as an adjunct to fusion as SRSs. This is also consistent with comments made at the 2013 Panel, in which the distinction between "semi-rigid" and "dynamic" systems was discussed. The features that may result in a device being classified as an SRS may include, but are not limited to, polymer cords, moveable screw heads, or springs. "Dynamic stabilization systems" for use in non-fusion procedures remain a postamendments class III device requiring PMAs.

## 2. Classification

In the 2014 Proposed Order, which was issued pursuant to sections 513(e)(1) and 515(i)(2) of the FD&C Act, FDA initially recommended that SRSs be classified into class III and require PMAs. Some commenters agreed with FDA's class III recommendation and other commenters proposed that SRSs be classified into class II.

(Comment 10) One comment agreed that SRSs for non-fusion uses should remain in class III, but SRSs used as an adjunct to fusion should be classified as class II. The commenter described that "[w]e believe that this matter arose after two [SRS] products from two different manufacturers were recalled in 2008 and 2009. These two recalled devices created FDA concern over the entire category of [SRS], calling into question whether preclinical testing alone is sufficient to predict clinical outcomes for these devices. Other SRSs have not been recalled, nor

are there significant safety concerns with these other [SRSs]." Another commenter conducted a Medical Device Reporting (MDR) analysis, which separated out PEEK rods from other SRSs to demonstrate a similarity in reporting of adverse events associated with PEEK rods to that of traditional metallic rods.

Commenters specifically recommend that PEEK, or carbon-fiber reinforced PEEK, should remain in class II. This is based on several reported studies that demonstrate similarities in safety profiles and effectiveness outcomes for these devices as compared to devices incorporating traditional metallic rods, as also described previously in Comment 9 (Refs. 3 to 5). Two non-clinical literature articles provided in response to the proposed order demonstrate similar behavior between systems with PEEK rods and those with titanium rods.

Commenters also provided references to clinical studies using SRSs (Refs. 7 to 9). Each of these studies demonstrates fusion rates within a range deemed to be clinically acceptable in single- or multilevel posterolateral fusion using PEEK rod constructs.

(Response 10) Based on these comments to the proposed order and to corroborate findings from the literature following the 2013 Panel meeting, FDA conducted an additional MDR analysis of SRSs excluding the two recalled systems, as well as an MDR analysis of PEEK rods alone.

A search of the Manufacturer and User Facility Device Experience database was conducted to identify the relevant MDRs and identify the types of adverse events reported for pedicle screw spinal systems on or before October 17, 2016. Results from this MDR analysis demonstrated that the same types of adverse events are present in the same relative incidence for SRS devices as noted in traditional rigid pedicle screw systems (i.e., the most common adverse

events are device breakage, revision, and pain in all groups). FDA believes this evidence demonstrates that SRS devices have the same risks to health as rigid pedicle screw systems.

FDA additionally conducted an independent survey of literature published after the 2013 Panel related to the use of SRSs as an adjunct to fusion to assess current surgical practice and reported treatment outcome. FDA's literature search captured the articles identified previously in the comments as well as articles pertaining to additional SRS designs that have been cleared for marketing in the United States (Refs. 10 and 11). While only a subset of the 16 SRSs that have currently been determined to be substantially equivalent are represented in the literature, a wide range of currently cleared SRS designs is represented by this subset. The data demonstrated similar safety profiles for SRSs compared to traditional rigid pedicle screw systems. The adverse events reported in the literature for SRSs are similar to those cited in the Executive Summary for the 2013 Panel Meeting for traditional rigid pedicle screw systems used in currently class III indications that we proposed to reclassify to Class II rods (Ref. 2). Typical adverse events included pseudarthrosis, reoperation, screw loosening, and screw breakage. There were no reports of breakage of the longitudinal members of any of the SRSs studied.

The fusion rates of SRSs compare favorably to fusion rates of traditional systems for treatment of low-grade spondylolisthesis and DDD, which range from 78 to 100 percent and which the 2013 Panel deemed to be clinically acceptable to support reclassification for these indications (see the 2013 Panel Executive Summary for additional information (Ref. 2)). Based upon the currently available information, FDA agrees with the Panel's assessment that a fusion rate within the range of 78 to 100 percent would be clinically acceptable. Although the information presented to the 2013 Panel was limited in both the number of subjects and the number of SRSs represented, additional information that FDA received and considered after the



2013 Panel meeting supports FDA's determination that there is sufficient information to revise the proposed classification of SRSs from class III to II. FDA believes that the range of fusion rates found clinically acceptable by the 2013 Panel could serve as a performance parameter for providing reasonable assurance of safety and effectiveness for the device type based on the valid scientific evidence but due to some variability (e.g., design and material used) among individual devices, FDA has determined that clinical data are needed to demonstrate that each device with its specific characteristics (e.g., design and material used) and conditions of use meets that parameter. FDA believes that fusion rates higher than the current clinically acceptable range may be achieved with improvement in technology and, thus, may consider that factor in evaluating clinical data submitted from firms.

Based upon the information provided in response to the proposed order, and including additional analyses of the literature and MDRs since the 2013 Panel, FDA has determined that the risks to health are not substantially different from traditional rigid pedicle screw spinal systems. As discussed previously and in the 2014 Proposed Order, FDA agreed with the 2013 Panel that there is valid scientific evidence on the safety of rigid pedicle screw systems. FDA has also determined, as discussed previously, that an evaluation of additional MDR data and additional clinical literature provide valid scientific evidence regarding the safety of SRS devices for fusion (Refs. 3 to 11).

Whereas non-clinical performance testing appropriately mitigates the risks to health for rigid pedicle screw systems, non-clinical special controls are not sufficient to mitigate the risks to health, specifically, the risk of pseudarthrosis resulting in additional surgical procedures, for SRS devices. Non-clinical performance testing (such as standardized test methods or biomechanical testing of cadaveric specimens) does not adequately differentiate between

different SRS technologies nor predict the ability to achieve spinal fusion with a particular SRS. While some SRSs can be tested using the typical bench testing as a means of comparing performance of traditional rigid pedicle screw systems (e.g., per ASTM F1717-15, "Standard Test Methods for Spinal Implant Constructs in a Vertebrectomy Model"), this testing may result in lower bending stiffness for SRSs than similarly sized uniform metallic rods (Ref. 12). Testing in accordance with ASTM F1717-15 is not typically used to evaluate SRS technologies as significant modifications to the test standards are often necessary to conduct the test. Given that the systems have not typically been tested in accordance with the accepted consensus standard and as standardized acceptance criteria for SRS technologies undergoing this testing have not been developed, it is challenging to solely use the results of non-clinical performance testing for comparison purposes to rigid pedicle screw systems.

While clinical data as a special control was not specifically mentioned in the comments, the 2013 Panel discussed the ability for clinical data to distinguish between successful and unsuccessful SRS device designs. FDA believes that clinical performance data would adequately mitigate the risks to health for SRS devices, particularly the risk of pseudarthrosis resulting in additional surgical procedures. In addition, there is sufficient valid scientific evidence showing that the device type is effective for use as an adjunct to fusion, when the fusion rate is within a clinically acceptable range, as discussed previously. FDA therefore believes there is sufficient information to establish special controls that, in addition to general controls, can provide a reasonable assurance of safety and effectiveness for SRSs. Table 1 summarizes how FDA believes the risks to health identified for SRSs can be mitigated by special controls, including clinical performance data.

Table 1.--Risks to Health and Mitigation Measures for SRSs

Identified Risks to Health	Mitigation Method
Device failure	Design characteristics Non-clinical performance testing Labeling
Failure of bone implant interface	Design characteristics Biocompatibility evaluation Non-clinical performance testing Labeling
Tissue injury	Labeling
Adverse tissue reaction	Design characteristics Biocompatibility evaluation Sterility Labeling
Device malposition	Labeling
Pseudarthrosis	Non-clinical performance testing Clinical performance testing Labeling

As discussed in FDA's response to Comment 1, the risks to health and associated mitigation measures for rigid pedicle screw systems remain unchanged from those listed in table 1 of the 2014 Proposed Order.

### 3. SRS as Class II Device

As stated previously, FDA has reevaluated all of the valid scientific evidence for SRSs in finalizing this order. As described in the proposed order and in section I of this order, FDA has satisfied the requirements under section 515(i)(2) of the FD&C Act for revising the proposed classification for SRSs. Under section 515(i)(2) of the FD&C Act, FDA has the authority to issue an administrative order revising the proposed classification of a device for which FDA has classified as a class III device and for which no administrative order has been issued calling for PMAs under section 515(b) of the FD&C Act, so that the device is classified into class I or class II, after issuance of a proposed order, a meeting of a device classification panel, and consideration of the comments of a proposed order. In determining whether to revise the proposed classification of a device or to require a device to remain in class III, FDA applies the criteria set forth in section 513(a) of the FD&C Act. Section 513(a)(1)(B) of the FD&C Act

defines class II devices as those devices for which the general controls in section 513(a)(1)(A) by themselves are insufficient to provide reasonable assurance of safety and effectiveness, but for which there is sufficient information to establish special controls to provide a reasonable assurance of safety and effectiveness of a device.

FDA has reviewed all of the initial procedures, scientific information presented at the 2013 Panel meeting, comments received from both the 2014 Proposed Order and 2009 Final Order under section 515(i)(1) of the FD&C Act calling for information on preamendment devices (74 FR 16214, April 9, 2009) for consideration of the classification of SRS devices under section 513(a) of the FD&C Act and has initiated revision of the proposed classification of the device under section 515(i)(2) of the FD&C Act.

The discussion at the 2013 Panel for SRSs was limited, as acknowledged by 2013 Panel members, by the small number of studies available at that time and reports in the MDRs regarding SRSs for fusion. Given limitations of the available data, in literature and MDR analysis, the 2013 Panel concluded that insufficient evidence was available to establish special controls. Although FDA recommended, and the 2013 Panel agreed, that a call for PMAs was the necessary measure to mitigate the risks to health for SRSs and ensure a reasonable assurance of safety and effectiveness, FDA has since reassessed the scientific evidence based upon comments received and additional information, reevaluating the scientific evidence presented at the 2013 Panel meeting to reconsider FDA's prior position regarding the necessary controls to provide reasonable assurance of safety and effectiveness for SRSs. Based on FDA's reevaluation of the available body of evidence, FDA has determined that sufficient information exists regarding the risks and benefits of SRSs for FDA to determine that general and special controls can provide reasonable assurance of the safety and effectiveness of the device type and, thus, revising the

proposed classification for these devices from class III to II under section 515(i)(2) of the FD&C Act is appropriate.

Also, at the 2013 Panel meeting, the panel did discuss the feasibility of clinical data as being able to potentially distinguish between successful and non-successful SRS designs, without specifically discussing what level of data would be necessary. After further review of the scientific literature and comments, FDA believes that clinical performance data as a special control would adequately mitigate the risks to health for SRS devices, particularly the risk of pseudarthrosis resulting in additional surgical procedures (see response to Comment 10 in section II.B.2).

Upon reevaluation of the scientific evidence and additional information, FDA has determined that SRS devices do not have the degree of risk of illness or injury designed to be eliminated or reduced by requiring the device to have an approved PMA under section 515(b)(2) of the FD&C Act. In addition, the level of scientific evidence evaluated has allowed FDA to determine that SRSs can be classified as class II with the establishment of special controls because sufficient valid scientific evidence exists to determine that general controls, in combination with special controls, are sufficient to provide a reasonable assurance of safety and effectiveness. FDA has determined that revision of the proposed classification of SRSs under section 515(i)(2) of the FD&C Act will allow these devices to be classified in class II subject to a clinical performance data special control. As a result, instead of calling for PMAs for SRSs, FDA is finalizing this order to revise the proposed classification for SRS devices from class III to class II (special controls) following reassessment of all relevant scientific evidence and comments received from the 2014 Proposed Order. FDA believes the clinical performance data

special control and other special controls, together with general controls, are sufficient to provide a reasonable assurance of safety and effectiveness for SRS devices.

#### IV. The Final Order

Under sections 513(e) and 515(i) of the FD&C Act, FDA is adopting its findings as published in the preamble to the proposed order with the modifications discussed in section II of this final order. FDA is issuing this final order to reclassify rigid pedicle screw systems and to revise classification of SRSs when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) when used as an adjunct to fusion from class III to class II and establish special controls for all SRSs by revising part 888. Rigid pedicle screw systems when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) and SRSs for any indication must comply with the special controls identified in this order (see Section V, "Implementation Strategy").

Section 510(m) of the FD&C Act provides that FDA may exempt a class II device from the premarket notification requirements under section 510(k) of the FD&C Act if FDA determines that premarket notification is not necessary to provide reasonable assurance of the safety and effectiveness of the devices. FDA has determined that premarket notification is necessary to provide reasonable assurance of safety and effectiveness of rigid pedicle screw systems and SRSs when intended to provide immobilization and stabilization of spinal segments

in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment). Therefore, these device types are not exempt from premarket notification requirements.

Following the effective date of this final order, firms marketing rigid pedicle screw systems when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) and SRSs for any indication must comply with the special controls set forth in this order (see section V, "Implementation Strategy").

#### V. Implementation Strategy

The special controls identified in this final order are effective as of the date of publication of this order, [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]. Both rigid pedicle screw systems and SRSs covered by this order must comply with the special controls following the effective date of the order. Specifically, devices subject to the special controls in this order include rigid pedicle screw systems intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment), and SRSs for any indication. However, FDA does not intend to enforce compliance with the special controls for currently legally marketed SRSs covered by this order until [INSERT DATE 30 MONTHS AFTER DATE OF PUBLICATION IN THE FEDERAL

REGISTER]. The 30-month enforcement discretion period was selected based on the following factors: (1) The 2014 Proposed Order initially called for PMAs containing clinical performance data to be submitted within a 30-month timeframe, and thus the request in this final order for 510(k) amendments, which include submission of clinical performance data as a special control, maintains the same expectation of sponsors; and (2) the effectiveness endpoint of fusion for SRSs is generally assessed at 1 to 2 years post-implantation, and thus if a new study were to be initiated to collect clinical performance data, FDA would expect the 30-month period to be appropriate for SRS and allow sponsors sufficient time to enroll patients, conduct the study, and analyze the data.

For those manufacturers who wish to continue to offer for sale currently legally marketed SRSs covered by this order, FDA expects them to submit an amendment to their previously cleared 510(k)s for the devices by [INSERT DATE 30 MONTHS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER] that demonstrates compliance with the special controls. This approach is consistent with prior final orders for reclassifications of preamendment devices in which special controls requiring submission of clinical performance data were issued. An amendment to a 510(k) will be added to the 510(k) file but will not serve as a basis for a new substantial equivalence review. A submitted 510(k) amendment in this context will be used solely to demonstrate to FDA that an SRS system is in compliance with the special controls. If a 510(k) amendment for the device is not submitted by [INSERT DATE 30 MONTHS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER] or if FDA determines that the amendment does not demonstrate compliance with the special controls, then this compliance policy would not apply, and FDA would intend to enforce compliance with these requirements. In that case, the device is deemed adulterated under section 501(f)(1)(B) of the



FD&C Act (21 U.S.C. 351(f)(1)(B)) as of the date of FDA's determination of noncompliance or [INSERT DATE 30 MONTHS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER], whichever is sooner.

For rigid pedicle screw systems intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) and SRSs for any indication that have not been legally marketed prior to [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER], or models that have been legally marketed but are required to submit a new 510(k) under 21 CFR 807.81(a)(3) because the device is about to be significantly changed or modified, manufacturers must obtain 510(k) clearance, among other relevant requirements, and demonstrate compliance with the special controls included in this final order, before marketing the new or changed device.

#### VI. Analysis of Environmental Impact

The Agency has determined under 21 CFR 25.34(b) that this action is of a type that does not individually or cumulatively have a significant effect on the human environment. Therefore, neither an environmental assessment nor an environmental impact statement is required.

#### VII. Paperwork Reduction Act of 1995

This final order refers to previously approved collections of information found in FDA regulations. These collections of information are subject to review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501-3520). The collections of information in part 807, subpart E, have been approved under OMB control

number 0910-0120 and the collections of information under 21 CFR part 801 have been approved under OMB control number 0910-0485.

#### VIII. Codification of Orders

Prior to the amendments by FDASIA, section 513(e) of the FD&C Act provided for FDA to issue regulations to reclassify devices. Although section 513(e) as amended requires FDA to issue final orders rather than regulations, FDASIA also provides for FDA to revoke previously promulgated regulations by order. FDA will continue to codify classifications and reclassifications in the CFR. Changes resulting from final orders will appear in the CFR as changes to codified classification determinations or as newly codified orders. Therefore, pursuant to section 513(e)(1)(A)(i) of the FD&C Act, as amended by FDASIA, in this final order, we are revoking the requirements in § 888.3070 related to the classification of rigid pedicle screw systems and SRSs when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) as class III devices. We are codifying the reclassification of rigid pedicle screw systems and SRSs when intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of DDD and spondylolisthesis (other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment) into class II (special controls). In addition, as set forth in the 2014 Proposed Order, FDA has separated SRSs, a subtype of pedicle screw systems, from rigid pedicle screw systems in the identification section of the classification

regulation (§ 888.3070(a)) and has established a separate subpart of the classification regulation (§ 888.3070(b)(3)), which is applicable to all SRSs regardless of indication.

#### IX. References

The following references are on display in the Division of Dockets Management (HFA-305), Food and Drug Administration, 5630 Fishers Lane, rm. 1061, Rockville, MD 20852, and are available for viewing by interested persons between 9 a.m. and 4 p.m., Monday through Friday; they are also available electronically at <https://www.regulations.gov>. FDA has verified the Web site addresses, as of the date this document publishes in the Federal Register, but Web sites are subject to change over time.

1. Matsuzaki, H., Y. Tokuhashi, F. Matsumoto, et al., "Problems and Solutions of Pedicle Screw Fixation of Lumbar Spine," Spine, 15(11):1159-1165, 1990.

2. FDA's Orthopedic and Rehabilitation Devices Panel transcript and other meeting materials are available on FDA's Web site at:  
<http://www.fda.gov/AdvisoryCommittees/CommitteesMeetingMaterials/MedicalDevices/MedicalDevicesAdvisoryCommittee/CirculatorySystemDevicesPanel/ucm352525.htm>.

3. Qi, L., M. Li, S. Zhang, et al., "Comparative Effectiveness of PEEK Rods Versus Titanium Alloy Rods in Lumbar Fusion: A Preliminary Report," Acta Neurochirurgica, 155(7):1187-1193, 2013.

4. Sengupta, D. K., B. Bucklen, P. C. McAfee, et al., "The Comprehensive Biomechanics and Load-Sharing of Semirigid PEEK and Semirigid Posterior Dynamic Stabilization Systems," Advances in Orthopedics, 2013. doi: 10.1155/2013/745610 (Epub); available at <https://www.hindawi.com/journals/aorth/2013/745610/>.

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6. Gornet, M. F., F. W. Chan, J. C. Coleman, et al., "Biomechanical Assessment of a PEEK Rod System for Semi-Rigid Fixation of Lumbar Fusion Constructs," Journal of Biomechanical Engineering, 133(8):081009, 2011. doi: 10.1115/1.4004862.
7. Athanasakopoulos, M., A. F. Mavrogenis, G. Triantafyllopoulos, et al., "Posterior Spinal Fusion Using Pedicle Screws," Orthopedics, 36(7):e951-e957, 2013. doi: 10.3928/01477447-20130624-28.
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9. De Iure, F., G. Bosco, M. Cappuccio, et al., "Posterior Lumbar Fusion by PEEK Rods in Degenerative Spine: Preliminary Report on 30 Cases," European Spine Journal, 21 Suppl 1:S50-54, 2012.
10. Ormond, D. R., L. Albert Jr., and K. Das, "Polyetheretherketone (PEEK) Rods in Lumbar Spine Degenerative Disease: A Case Series," Journal of Spine Disorders & Techniques, in press, 2012 (later published in 2016 under Clinical Spine Surgery, 29(7):E371-E375, 2016).
11. Yang, M., C. Li, Z. Chen, et al., "Short Term Outcome of Posterior Dynamic Stabilization System in Degenerative Lumbar Diseases," Indian Journal of Orthopaedics, 48(6):574-581, 2014.

12. ASTM F1717-15, "Standard Test Methods for Spinal Implant Constructs in a Vertebrectomy Model," July 2015; available at:

<https://www.astm.org/Standards/F1717.htm>.

List of Subjects in 21 CFR Part 888

Medical devices.

Therefore, under the Federal Food, Drug, and Cosmetic Act and under authority delegated to the Commissioner of Food and Drugs, 21 CFR part 888 is amended as follows:

**PART 888--ORTHOPEDIC DEVICES**

1. The authority citation for part 888 continues to read as follows:

Authority: 21 U.S.C. 351, 360, 360c, 360e, 360j, 371.

2. Section 888.3070 is amended by revising the section heading and paragraphs (a) and (b)(2), adding paragraph (b)(3), and removing paragraph (c).

The revisions and addition read as follows:

§ 888.3070 Thoracolumbosacral pedicle screw system.

(a) Identification. (1) Rigid pedicle screw systems are comprised of multiple components, made from a variety of materials that allow the surgeon to build an implant system to fit the patient's anatomical and physiological requirements. Such a spinal implant assembly consists of a combination of screws, longitudinal members (e.g., plates, rods including dual diameter rods, plate/rod combinations), transverse or cross connectors, and interconnection mechanisms (e.g., rod-to-rod connectors, offset connectors).

(2) Semi-rigid systems are defined as systems that contain one or more of the following features (including but not limited to): Non-uniform longitudinal elements, or features that allow more motion or flexibility compared to rigid systems.

(b) \* \* \*

(2) Class II (special controls), when a rigid pedicle screw system is intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion in the treatment of degenerative disc disease and spondylolisthesis other than either severe spondylolisthesis (grades 3 and 4) at L5-S1 or degenerative spondylolisthesis with objective evidence of neurologic impairment. These pedicle screw systems must comply with the following special controls:

(i) The design characteristics of the device, including engineering schematics, must ensure that the geometry and material composition are consistent with the intended use.

(ii) Non-clinical performance testing must demonstrate the mechanical function and durability of the implant.

(iii) Device components must be demonstrated to be biocompatible.

(iv) Validation testing must demonstrate the cleanliness and sterility of, or the ability to clean and sterilize, the device components and device-specific instruments.

(v) Labeling must include the following:

(A) A clear description of the technological features of the device including identification of device materials and the principles of device operation;

(B) Intended use and indications for use, including levels of fixation;

(C) Identification of magnetic resonance (MR) compatibility status;

(D) Cleaning and sterilization instructions for devices and instruments that are provided non-sterile to the end user; and

(E) Detailed instructions of each surgical step, including device removal.

(3) Class II (special controls), when a semi-rigid system is intended to provide immobilization and stabilization of spinal segments in the thoracic, lumbar, and sacral spine as an adjunct to fusion for any indication. In addition to complying with the special controls in paragraphs (b)(2)(i) through (v) of this section, these pedicle screw systems must comply with the following special controls:

(i) Demonstration that clinical performance characteristics of the device support the intended use of the product, including assessment of fusion compared to a clinically acceptable fusion rate.

(ii) Semi-rigid systems marketed prior to the effective date of this reclassification must submit an amendment to their previously cleared premarket notification (510(k)) demonstrating compliance with the special controls in paragraphs (b)(2)(i) through (v) and paragraph (b)(3)(i) of this section.

Dated: December 22, 2016.

Leslie Kux,

Associate Commissioner for Policy.

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